Proposed Agreement between California Energy Commission and The Regents of the University of California, Berkeley

Title: Analysis of the relationship between fog, energy demand for heating, and winter chill in the Central Valley
Amount: $82,510.00
Term: 12 months
Contact: Guido Franco
Committee Meeting: 10/12/2010

Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
09	Electric	EA	Global Climate Change	$4,323,000	$82,510	$0	0%

Recommendation

Approve this agreement with UC Berkeley for $82,887 to study the relationship between fog, energy consumption for heating, and winter chill hours in the agriculturally important Central Valley region. Staff recommends placing this item on the discussion agenda of the Commission Business Meeting.

Issue

Sustained periods of temperatures between zero and seven degrees Celsius (chill hours) are promoted by prolonged periods of radiative fog throughout the Central Valley during the winter. At present, there is anecdotal evidence from many long time residents in the Central Valley that winters are not as foggy as they used to be 30 plus years ago. Lesser winter chill hours and subsequent increases in mean daily temperature may lead to reduced energy use for heating in the Central Valley, but on the other hand, it may reduce the $10 billion dollar agricultural industry's yield. California's agribusiness is an important fuel in the state's economic engine that provides 95 percent of popular fruits and nuts for the entire U.S. It is important to qualitatively determine if the decrease in chill hours is associated with reduction in fog because these reductions may have energy, ecological, and economic implications. In addition, this information could be used to test or enhance regional climate models to more reliably estimate the impact of climate change on winter temperatures and heating demand.

Background

Preliminary analyses suggest that minimum daily temperatures are increasing in the Central Valley that could be related to the postulated changes in fog regimes. Higher minimum daily temperatures could result in a reduction in energy consumed for heating, after controlling for other factors such as urban growth. In addition, the cool, wet winter period in the Central Valley replenishes soil moisture and produces a period of dormancy (between 0 and 7 degrees Celsius) in the Central Valley needed to achieve sufficient dormancy for fruits and nuts (e.g., apricots, almonds, kiwis, olives, pistachios, etc.). Recent analyses of winter chill accumulation (Baldocchi & Wong 2008; Luedeling et al., 2009) show that winter chill has decreased by several hundred hours in California since the 1950s, trends ranging between -50 and -260 chill hours per decade. At present, the duration of winter chill is less than 1000 hours (a critical dormancy threshold for many fruits and nuts) at many locations across the Central Valley. Future scenarios, based on regional computations from global climate models, predict that this downward spiral in chill accumulation will continue in a linear fashion through the 21st century.

Proposed Work

A research team at UC Berkeley will conduct an analysis on long-term trends in winter fog across the fruit and nut growing region of California, the Central Valley, and estimate the effect of this trend on energy demand for heating. The researchers will use satellite imaging of fog (Advanced Very High Resolution Radiometer on the Geostationary Orbital Environmental Satellite) and climate data to study winter fog climatology in the Central Valley between November and February. Satellite data offers several advantages. First, it provides a direct measure of radiative fog, compared to weather stations that rarely report visibility and tend to infer fog from temperature, humidity and radiation measurements. Second, it produces a product with a wide spatial distribution of the presence or absence of fog, compared to sparse networks of weather stations that require spatial interpolation. Third, the number of weather stations that report fog are few and they tend to be associated with airports which may suffer from urban heat island effects.

Justification and Goals

This project "[will] advance energy science or technologies of value to California citizens..." (Public Resources Code 25620.(c)), and is part of a "full range of research, development, and demonstration activities that . . . are not adequately provided for by competitive and regulated markets (Public Resources Code 25620.1.(a)); and supports California's goal to continue research performed by the California Climate Change Center in evaluating the economic and ecological consequences of climate change and adaptation and mitigation strategies to preserve and improve quality of life per the Energy Action Plan 2005.

This project also supports two Executive Orders. Governor's Executive Order S-3-05 mandates the preparation of biennial impacts reports to be submitted to the Governor and the Legislature via the Secretary of the Environment and the Climate Action Team. The PIER program is in charge of the preparation of these assessments. Executive Order S-13-08 and the recently adopted 2009 California Climate Adaptation Strategy orders the Energy Commission to continue supporting climate change research to provide the scientific basis for the development of adaptation strategies for California. The proposed project will develop new fog maps for the Central Valley and also contribute to the verification of regional climate models' predictive power pivotal in research and long-term adaptative planning.

This will be accomplished by:

- Estimating trends of fog regimes in the Central Valley of California and its implications for energy demand for space heating.